CERTIFICATE

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By the Authority Vested By Part 5 of the United States Code § 552(a) and Part 1 of the Code of Regulations § 51 the attached document has been duly INCORPORATED BY REFERENCE and shall be considered legally binding upon all citizens and residents of the United States of America. *HEED THIS NOTICE*: Criminal penalties may apply for noncompliance.

* * *

Document Name: ABYC A-16: Electric Navigation Lights

CFR Section(s): 46 CFR 25.10-3(a)(2)

Standards Body: American Boat and Yacht Council

Official Incorporator:
The Executive Director
OFFICE OF THE FEDERAL REGISTER
WASHINGTON, D.C.

A-16 ELECTRIC NAVIGATION LIGHTS

Based on ABYC's assessment of the existing technology, and the problems associated with achieving the goals of this standard, ABYC recommends compliance with this standard for all boats and associated equipment manufactured and/or installed after July 31, 1998.

16.1 *PURPOSE*

These standards and recommended practices are guides for the design, construction, performance, and installation of electric navigation lights.

NOTE: The United States Coast Guard has promulgated mandatory requirements for navigation lights in its Navigation Rules: International - Inland. Refer to these Rules for complete, current federal requirements. The USCG publication also contains the International Regulations for Prevention of Collisions at Sea, 1972 (72 COLREGS). The subsequent amendments to the 72 COLREGS are also contained in this publication.

16.2 *SCOPE*

These standards and recommended practices apply to the electric navigation lighting of vessels under 20 meters in length.

16.3 *REFERENCED ORGANIZATIONS AND PUBLICATIONS*

ABYC - American Boat & Yacht Council, Inc., 3069 Solomon's Island Road, Edgewater, MD 21037 410-956-1050

72 COLREGS - International Regulations for Preventing Collisions at Sea and/or the *Navigation Rules: International - Inland* - Obtain the *Navigation Rules* from either the Superintendent of Documents, United States Government Information, POB 371954, Pittsburgh, PA 15250-7954 202-512-1800, or fax 202-512-2250; or from ABYC, Inc., 3069 Solomons Island Road, Edgewater, MD 21037-1416 410-956-1050, or fax 410-956-2737

CFR - Obtain the *Code of Federal Regulations* and other government publications from the Superintendent of Documents, United States Government Information, POB 371954, Pittsburgh, PA 15250-7954 202-512-1800, or fax 202-512-2250. An excerpted edition of the *CFR* is available from ABYC, Inc., 3069 Solomon's Island Road, Edgewater, MD 21037 410-956-1050, or fax 410-956-2737

16.4 *DEFINITIONS*

All-round light - A light showing through 360^0 horizontally.

72 COLREGS - The International Regulations for Preventing Collisions at Sea, 1972.

NOTE: These regulations are contained in USCG Navigation Rules: International-Inland.

Combination sidelight (combined lantern) - A form of sidelights in a single fixture showing green to starboard and red to port from dead ahead to 22.5^0 abaft the beam (90° + 22.5° = 112.5°) on their respective sides.

Datum water line - A reference plane established for design purposes that is intended to approximate the final floating position of a vessel.

Design voltage - The input voltage necessary for a lamp to operate at the rated candlepower or the rated wattage, if rated candlepower is not specified.

Fixture - An assembly of components forming a navigation light.

Inland Rules - The Inland Navigational Rules

NOTE: These regulations are contained in USCG Navigation Rules: International-Inland.

Lamp - The bulb producing the light.

Masthead light - A white light showing an unbroken light over an arc of the horizon of 225^0, fixed to show the light from dead ahead to 22.5^0 abaft the beam (90° + 22.5° = 112.5°) on either side of the vessel.

Nominal voltage - Those commonly used voltages, such as 6, 12, 24, 32 volts DC and 110/220 volt AC.

Sidelights - The starboard side light showing green, and the port side light showing red, from dead ahead to 22.5^0 abaft the beam (90° + 22.5° = 112.5°) on their respective sides.

Static floating position - The attitude in which a boat floats in calm, fresh water, with fuel tanks filled to rated capacity, but with no person or item of portable equipment aboard. The boat should include all permanently installed, factory supplied equipment and options such as, but not limited to, the engine or engines, batteries, seats, engine oil, railings, fishing towers, etc., but not portable gear such as, flags, search lights, movable cushions, mattresses, portable fire extinguishers, lines, fenders, chairs, tables, anchors, chain, or PFDs. If the boat has a water tank, or live bait well, it should be empty.

Stern light - A white light placed as nearly as practicable at the stern showing an unbroken light over an arc of the horizon of 135°, and fixed to show the light 67.5° from directly aft on each side of the vessel.

Towing light - A yellow light having the same characteristics as the stern light, except that the color is yellow in accordance with A-16, Table I.

Tri-colored light - Sidelights and a stern light combined in a single fixture.

NOTE: The International Maritime Organization (IMO) has clarified the use of "lantern," as in "combined lantern," and "light," as in "sidelight," as being the same. "Light" and "lantern," in this context, are the same and interchangeable, and mean the whole fixture.

16.5 *REQUIREMENTS - IN GENERAL*

16.5.1 If installed, navigation lights shall comply with the *International Regulations for Preventing Collisions at Sea, 1972 (72 COLREGS)*, or the *Inland Navigation Rules* as follows:

16.5.1.1 *International Rules (72 COLREGS)* lights are required offshore of lines of demarcation as described in the US *Code of Federal Regulations*, Title 33, Part 80.

16.5.1.2 All vessels may use either *72 COLREGS* or *Inland Rules'* lights on the navigable waters of the US inshore of the lines of demarcation.

16.5.2 Navigation lights and their installation shall comply with the positioning and technical requirements in the rules and regulations in regard to the distances various lights shall be visible, where each light shall be located on a vessel, the arcs of visibility, and chromaticity.

NOTES: 1. The diagrams in this standard do not necessarily show every possible configuration alternative permitted under the rules, but they do show typical arrangements of navigation lights derived by considering the intent of the rules and the principles of good seamanship.

2. It is impractical to make detailed recommendations to cover all cases. The arrangements shown in the diagrams and the configurations recommended should be approached as closely as the configuration of a particular vessel will permit, but within the specifications of the rules. If deviations from the recommendations are necessary, the locations selected shall be checked for compliance with the appropriate rules.

3. Under certain operating conditions, configurations in addition to those recommended in ABYC A-16.7 may be required by the rules, i.e., towing lights. Configurations for these conditions are not indicated within this standard. However, the light fixtures shall conform to all applicable requirements of this standard.

16.6 REQUIREMENTS - SPECIFIC LOCATION AND INSTALLATION

16.6.1 Lights shall not be obscured by fixed structures or optional equipment under normal operating conditions.

EXCEPTIONS: 1. In accordance with the COLREGS and Inland Rules, all-round lights may not be obscured by masts, topmasts, or structures within angular sectors of more than 6°.

2. Anchor lights, which need not be placed at an impracticable height above the hull.

16.6.2 Navigation lights shall be installed

16.6.2.1 to prevent the lights from shining into the operator's eyes when the operator is in the normal operating position, and

16.6.2.2 to prevent reflection off a vessel's structure within the operator's field of vision. See Figure 4.

NOTE: This does not cover reflected glare or loom light from atmospheric vapor, such as fog or mist.

16.6.2.3 The luminous intensity of navigation lights shall not be adjustable by any variable control.

16.6.3 The all-round light shall not be directly visible from the operator's position. See Figure 4.

16.6.4 Light fixtures shall be mounted to ensure that the light shows over the required arcs of visibility, and shall satisfy the required vertical separation and location requirements when the vessel is in a static floating position, or when measured using the datum water line as a reference. See Figures 5 and 6.

16.6.5 All craft on which navigation lights are provided shall incorporate a provision for displaying an anchor light. When a vessel uses electric lights, one operation, such as one switch or one position of a switch, shall display the complete navigation light configuration as required for the vessel while underway. Another switch or switch position shall display the anchor light only.

16.6.6 Navigation lights shall be mounted so as to minimize damage by contact with other objects under normal operating conditions.

16.6.7 Navigation lights shall be installed in accordance with ABYC E-8, *Alternating Current (AC) Electrical Systems on Boats*, or ABYC E-9, *Direct Current (DC) Electrical Systems on Boats*, as appropriate.

NOTE: ABYC E-9 requires that conductors used in navigation light wiring be sized for no more than three percent voltage drop.

16.6.8 If a metallic fixture frame or enclosure has a current carrying connection, attached as permitted in A-16.8.8 in a system of 12 volts or less, it shall be mounted on an electrically non-conductive surface and the polarity of the fixture leads shall be observed.

16.7 *CONFIGURATION - RANGE AND POSITIONING REQUIREMENTS*

16.7.1 Power Driven Vessels - Underway. See Figures 1 and 3.

16.7.1.1 Vessels Under 12 Meters in Length. See Figures 1 and 3.

16.7.1.1.1 A white masthead light forward, visible two nautical miles, over the fore and aft centerline, one meter minimum above the sidelights, AND

16.7.1.1.2 separate sidelights, visible one nautical mile, one meter minimum below the masthead light, AND

16.7.1.1.3 a white sternlight, visible two nautical miles, as nearly as practicable at the stern;

OR

16.7.1.1.4 a white masthead light forward, visible two nautical miles, which may be displaced from the fore and aft centerline if centerline fitting is not practicable, one meter minimum above the combination sidelight, AND

16.7.1.1.5 a combination sidelight, visible one nautical mile, as nearly as practicable in the same fore and aft line as the masthead light, AND

16.7.1.1.6 white sternlight, visible two nautical miles, as nearly as practicable at the stern,

OR

16.7.1.1.7 a white, all-round light, visible two nautical miles(*), placed as nearly as practicable to the fore and aft centerline. If centerline fitting is not practicable, one meter minimum above the combination sidelight, AND

16.7.1.1.8 a combination sidelight visible one nautical mile, as nearly as practicable on the same fore and aft line as the all-round light, or located as nearby as practicable in the same fore and aft line as the masthead light or the all-round white light,

OR

16.7.1.1.9 a white, all-round light visible two nautical miles(*), over the fore and aft centerline, one meter minimum above the sidelights, AND

16.7.1.1.10 separate sidelights, visible one nautical mile.

(*) ***NOTE: The white all-round light is in lieu of the masthead light and the sternlight.***

16.7.1.2 Vessels 12 Meters to Less Than 20 Meters in Length. See Figures 1 and 3.

16.7.1.2.1 A white masthead light forward, visible three nautical miles, placed over the fore and aft centerline of the vessel, 2.5 meters minimum above the gunwale, AND

16.7.1.2.2 separate sidelights visible two nautical miles, not higher than 3/4 of the height that the masthead light is above the gunwale, AND

16.7.1.2.3 a white sternlight visible two nautical miles, as nearly as practicable at the stern,

OR

16.7.1.2.4 a white masthead light forward, visible three nautical miles, placed over the fore and aft centerline of the vessel, 2.5 meters minimum above the gunwale, one meter minimum above the combination sidelight, AND

16.7.1.2.5 a combination sidelight visible two nautical miles, over the fore and aft centerline, not higher than 3/4 of the height that the masthead light is above the gunwale, AND

16.7.1.2.6 a white sternlight visible two nautical miles, as nearly as practicable at the stern.

16.7.2 Sailing Vessel - Under Sail Alone. See Figure 2.

16.7.2.1 Sailing Vessels Under 12 Meters in Length. See Figure 2.

16.7.2.1.1 Separate sidelights visible one nautical mile, AND

16.7.2.1.2 a white sternlight visible two nautical miles, placed as nearly as practicable at the stern,

OR

16.7.2.1.3 a combination sidelight visible one nautical mile, on the fore and aft centerline, AND

16.7.2.1.4 a white sternlight visible two nautical miles, placed as nearly as practicable at the stern, OR

16.7.2.1.5 a tri-color masthead light, the red and green sectors visible one nautical mile, the white stern sector visible two nautical miles(*).

NOTE: The tri-color masthead light indicates a sailing vessel that is under sail alone, and must not be displayed when the vessel is under power, or when under sail and power. Under these conditions, the configurations applicable to a power vessel apply. Therefore, provision shall be made to display the two configurations separately, not simultaneously.

16.7.2.2 Sailing Vessels 12 to Less Than 20 Meters in Length. See Figure 2.

16.7.2.2.1 Separate sidelights visible two nautical miles, AND

16.7.2.2.2 a white sternlight visible two nautical miles, placed as nearly as practicable at the stern,

OR

16.7.2.2.3 a combination sidelight visible two nautical miles, placed over the fore and aft centerline, AND

16.7.2.2.4 a white sternlight visible two nautical miles, placed as nearly as practicable at the stern,

OR

16.7.2.2.5 a tri-color masthead light visible two nautical miles.

16.7.3 Vessels at Anchor. See Figure 3, Vessels Under 12m, Note 2, and Vessels 12 - 20m, Note 4.

16.7.3.1 Where it can best be seen, an all-round white light visible two nautical miles.

16.8 *DESIGN AND CONSTRUCTION REQUIREMENTS*

16.8.1 The materials and methods of securing the fixture components shall ensure the maintenance of a fixed relationship during the normal service life of the assembly.

16.8.2 External and internal parts of the light assembly shall be designed and finished so that roughness and sharp edges liable to cause injury while servicing or using the unit are minimized or adequately protected.

16.8.3 Means shall be provided to assist in the proper alignment of the fixture.

16.8.4 Navigation lights shall be designed and installed to minimize the entry and internal accumulation of water or moisture as installed.

16.8.4.1 Lights installed below the sheer line shall be watertight. See Appendix B1.

16.8.4.2 Lights installed above the sheer line shall be weathertight. See Appendix B2.

16.8.5 Gaskets shall be reusable, and capable of withstanding the temperatures and exposure to salt water encountered in service so as to maintain their function.

16.8.6 Provision shall be made for replacement of the lamp or lamps used so that it can be accomplished by one person using ordinary hand tools.

16.8.7 Lamp sockets shall be designed to provide a strong mechanical and electrical connection with each conductor, and

16.8.7.1 the wiring shall be in accordance with the applicable requirements of ABYC E-8, *Alternating Current (AC) Electrical Systems on Boats,* or ABYC E-9, *Direct Current (DC) Electrical Systems on Boats.*

16.8.8 Metallic fixtures for use in systems of over 12 volts (nominal) shall not have a normally current carrying connection attached to the fixture frame or enclosure. Metallic fixtures for use in systems of 12 volts nominal or less may have a normally current carrying connection attached to the fixture frame or enclosure, subject to the following restrictions;

16.8.8.1 that only the negative lead be attached, and

16.8.8.2 that the polarity of both the positive and negative connections be identified, and

16.8.8.3 that the manufacturer of a metal fixture shall provide a means to convey the following information;

16.8.8.3.1 that the negative lead is connected to the case, and

16.8.8.3.2 that polarity must be observed to avoid energizing the case, and to minimize stray current corrosion; and

16.8.8.3.3 that the fixture should be mounted only on a non-conductive surface.

16.8.8.4 If a label is used to comply with 16.8.8.3, it shall comply with the requirements of ABYC T-5, *Safety Signs and Labels,* and shall contain at least the following informational elements:

1. The hazard intensity signal word;
2. The nature of the hazard;
3. The consequences that can result if the instructions to avoid the hazard are not followed;
4. Instructions on how to avoid the hazard.

NOTE: An example of such a label follows:

⚠ CAUTION

NEGATIVE LEAD CONNECTED TO CASE.
TO AVOID ENERGIZING CASE,
AND TO MINIMIZE
STRAY CURRENT CORROSION,
OBSERVE POLARITY,
AND MOUNT ONLY ON A
NON-CONDUCTIVE SURFACE.

EXCEPTION to 16.8.8.3: If the base of the fixture is non-conductive, and is designed to electrically isolate the metallic fixture, frame, or enclosure from the mounting surface, the manufacturer may convey the following:

1. that the negative lead is connected to the case, and

2. polarity must be observed to avoid energizing the case.

If a label is used to convey this information it shall comply with the requirements of 16.8.8.4.

An example of such a label follows:

⚠ CAUTION

NEGATIVE LEAD CONNECTED TO CASE.
TO AVOID ENERGIZING CASE,
OBSERVE POLARITY.

16.8.9 Each navigation light fixture shall bear the following information in an accessible location;

16.8.9.1 the manufacturer's name or identifying mark, and

16.8.9.2 designation of the proper replacement lamp, and

16.8.9.3 the mark *A-16*, that shall indicate design conformance with this standard.

16.8.10 Means shall be provided to identify the fixture's intended use, e.g., type of vessel, longest vessel on which the fixture can be used, and nominal voltage.

16.8.11 Navigation lights shall be manufactured to prevent reversing the colored lens(s) in their fixtures.

16.8.12 All fixture markings shall be tested for exposure to water, salt, spray, direct sunlight, heat, cold, and wear in accordance with the requirements of UL1104, *Marine Navigation Lights*. .

16.8.13 Color and photometric requirements shall be tested in accordance with A-16.9 and A-16.10, and the procedures contained in the appendix, or in accordance with UL1104, *Marine Navigation Lights*.

NOTE: Other test procedures may be employed provided they produce equivalent results.

16.9 *COLOR AND PHOTOMETRIC REQUIREMENTS*

16.9.1 Navigation lights shall be designed to conform to the color, intensity, and cut-off requirements with a test lamp specified for the fixture. See Table I.

16.9.2 Chromaticity - The chromaticity of the test fixture shall conform to Table I in accordance with the 72 COLREGS.

16.9.3 Luminous Intensity - The minimum required intensity is given by range in Table II.

16.9.4 Luminous intensity distribution and cut-off are defined in Figures 5 and 6 . The percentages specified are those of the minimum luminous intensity specified in Table II, corresponding to the range of visibility for which the fixture is designed.

16.10 *TEST CONDITIONS*

16.10.1 The test fixture used in checking chromaticity, luminous intensity, and cut-off requirements shall be representative of standard fixtures in regular production, but does not have to be a production fixture.

16.10.2 The fixture under test shall be properly seasoned using a representative production lamp so that the measurements taken on the fixture are stabilized.

16.10.3 The lamp used in the test shall be the same as the lamp specified by the navigation light manufacturer and shall be tested at 107% of the intended nominal system voltage.

16.10.4 Test lamp position and test fixture may be adjusted within production tolerances.

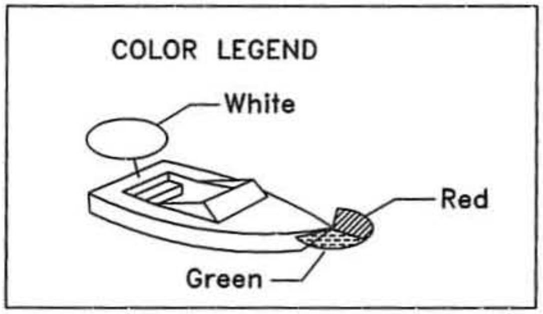
16.10.5 Test Records - The following test records shall be maintained:

16.10.5.1 The test fixture used to determine compliance;

16.10.5.2 Colorimetric and photometric reports on the test fixture;

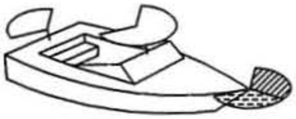
16.10.5.3 Records necessary to determine that the production fixtures are representative of the test fixture.

FIGURE 1 - POWER DRIVEN VESSELS UNDERWAY (INCLUDING SAILBOATS UNDERWAY UNDER POWER) UNDER 20 METERS



UNDER 12 METERS

White Masthead Light Visible	2 Miles
Sidelights or Combination Light Visible	1 Mile
Sternlight or All-round Light Visible	2 Miles



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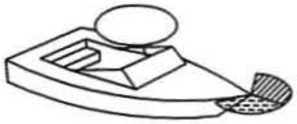

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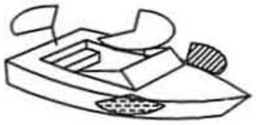

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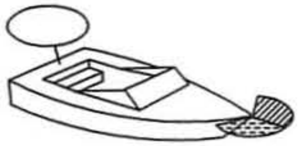

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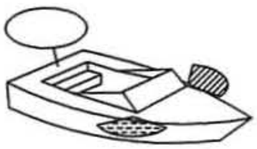
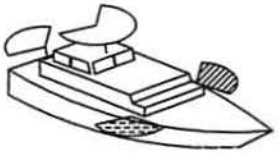


12 – 20 METERS

White Masthead Light Visible	3 Miles
Sidelights or Combination Light Visible	2 Miles
Sternlight or All-round Light Visible	2 Miles



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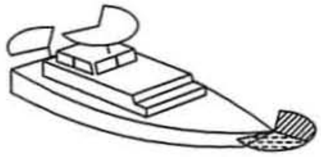

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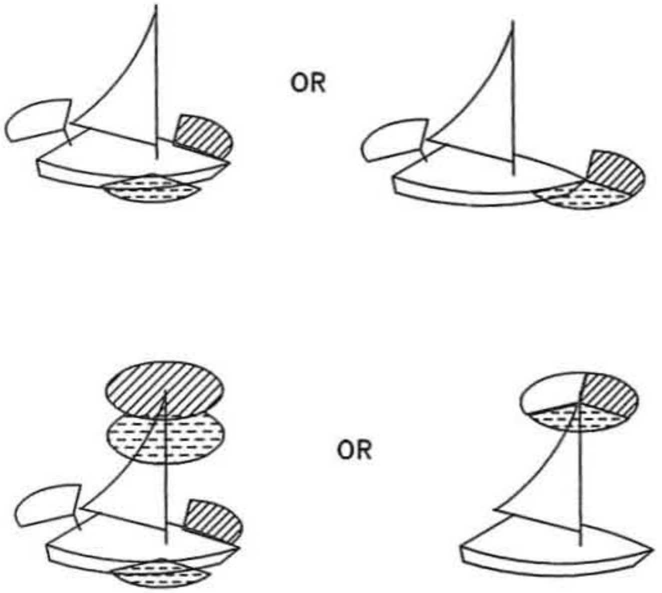
FIGURE 2 - SAILING VESSELS UNDER 20 METERS IN LENGTH - UNDER SAIL ALONE

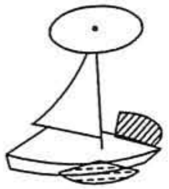
	Under 12 meters	12 - 20 meters
Sidelights or combination light visible	1 mile	2 miles
Sternlight visible	2 miles	2 miles

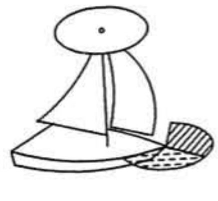


NOTE: Different light configurations must be shown when under sail and power, or under power alone.

FIGURE 3 - VESSEL UNDER SAIL AND POWER OR SAILBOAT UNDER POWER ALONE

Vessels Under 12m	
White masthead light visible	2 miles
Sidelights or combination light visible	1 mile
Sternlight visible	2 miles





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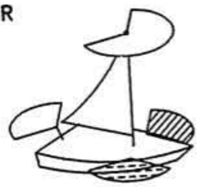

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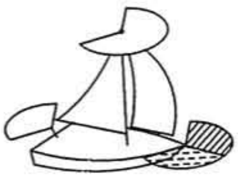
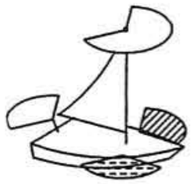


NOTES: 1. These configurations are optional. Configurations shown in Figure 1 are also acceptable.
2. All-round light may serve as anchor light.

Vessels 12 - 20m	
White masthead light visible	3 miles
Sidelights or combination light visible	2 mile
Sternlight visible	2 miles



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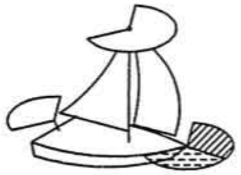


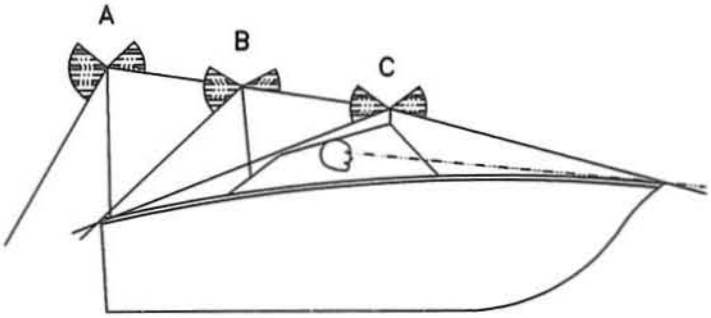
NOTES: 1. Lights designed for a vessel 12 meters to less than 20 meters in length may be used on a vessel under 12 meters in length.

2. A vessel under sail and power, or a sailboat (auxiliary) under power alone, for purposes of light configurations, is considered a power driven vessel when underway.

3. Different light configurations must be shown when under sail alone.

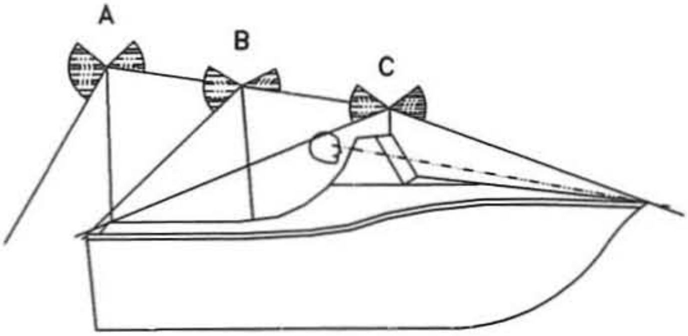
4. An all-around white light can serve as an anchor light.

FIGURE 4 - EXAMPLES OF WHITE LIGHT PLACEMENTS TO REDUCE GLARE



For All-round lights, A, B or C may be used if fixture is properly designed or shielded. Note that pole height must be increased as light is moved aft.

Boat Designed For Sit-down Operation
All-round Lights



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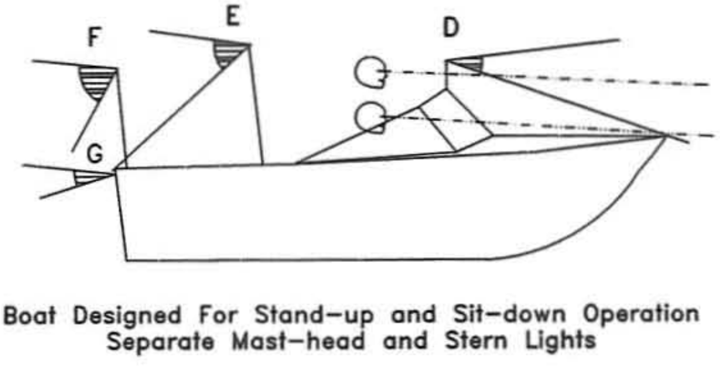
Boat Designed For Stand-up and Sit-down Operation
All-round Lights

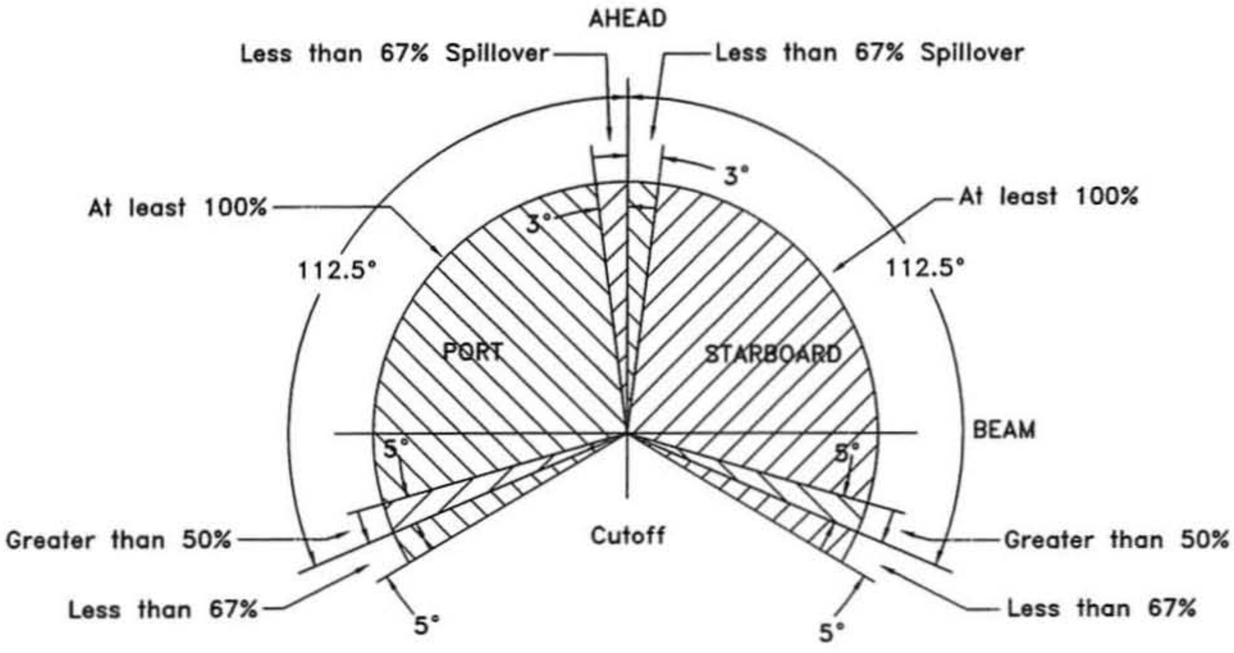


For separate mast-head and stern lights, E, F or G may be used, in conjunction with D.

Boat Designed For Stand-up and Sit-down Operation
Separate Mast-head and Stern Lights

FIGURE 5 - HORIZONTAL SECTOR INTENSITY REQUIREMENTS

SIDELIGHTS OR MASTHEAD LIGHTS



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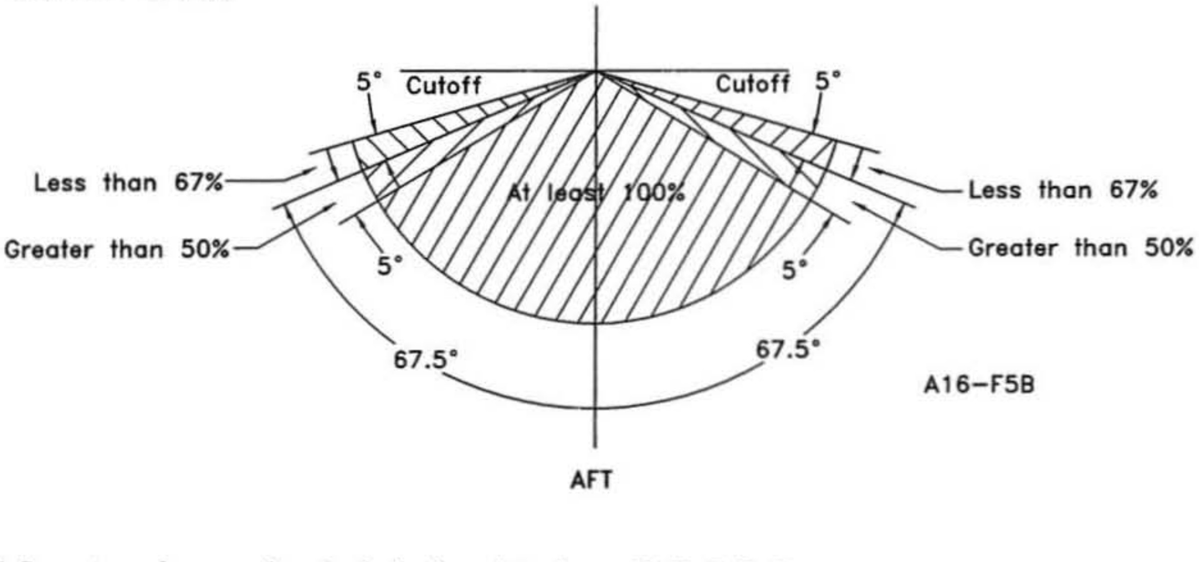
STERN LIGHT



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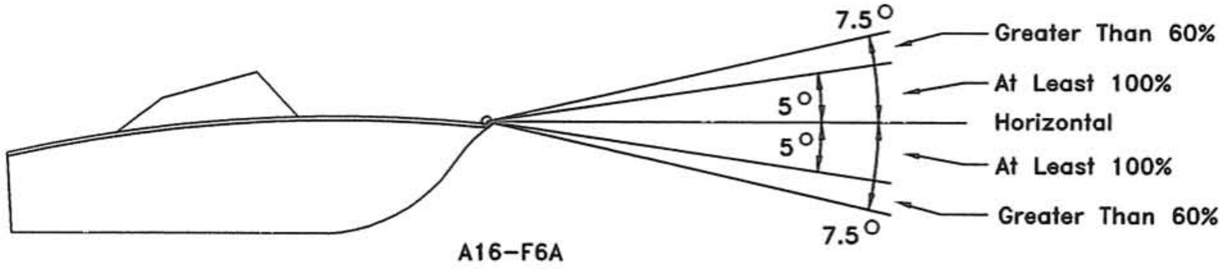
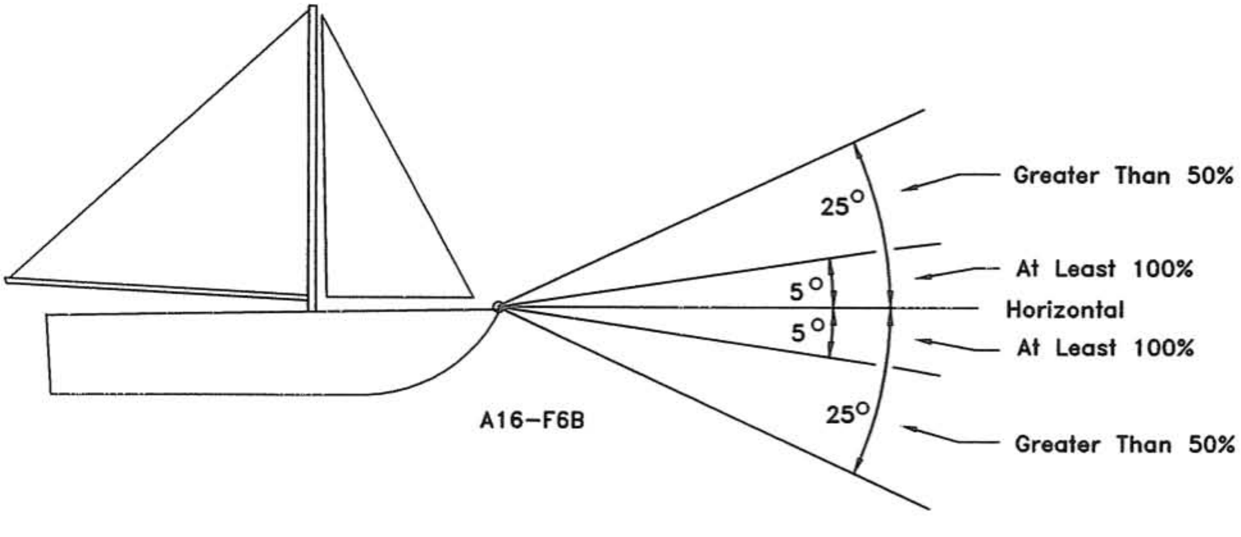
NOTE: Percentages shown are those for the luminous intensity specified in Table II.

FIGURE 6 - VERTICAL SECTOR INTENSITY REQUIREMENTS (ELEVATION)

POWER BOAT ONLY



SAIL BOAT UNDER SAIL ONLY



NOTE: Percentages shown are those for the luminous intensity specified in Table II.

TABLE I - COLOR CORNER COORDINATES

White:

x	0.525	0.525	0.452	0.310	0.310	0.443
y	0.382	0.440	0.440	0.348	0.283	0.382

Green:

x	0.028	0.009	0.300	0.203		
y	0.385	0.723	0.511	0.356		

Red:

x	0.680	0.660	0.735	0.721		
y	0.320	0.320	0.265	0.259		

Yellow:

x	0.612	0.618	0.575	0.575		
y	0.382	0.382	0.425	0.406		

TABLE II - LUMINOUS INTENSITY

Range of Visibility (luminous range) of light in nautical miles	Minimum luminous intensity in Candelas, using "K" factor of 0.80 (atmospheric transmissivity)
1	0.9
2	4.3
3	12.0

A-16 APPENDIX A - ELECTRIC NAVIGATION LIGHTS

This appendix is devoted to providing one method of testing navigation light fixtures. This testing method, when used with sections A-16.9, *Color and Photometric Requirements*, and A-16.10, *Test Conditions*, contained in A-16 shall be sufficient to determine navigation light conformance to the color and photometric requirements of A-16. Other test procedures may be employed provided they produce equivalent results.

Ap.A.1 *CHROMATICITY TEST PROCEDURES*

Ap.A.1.1 Source - Chromaticity shall be measured using a test lamp operated at 2856^0 Kelvin (CIE Illuminant A), or by using a seasoned test lamp similar to the one used in the fixture design, and operated at design amperage or voltage. Design conformance shall be considered to be met if any one of the three alternative test methods above meets the chromaticity requirements.

Ap.A.1.2 Method - Color measurements shall be accomplished in accordance with Section 3, *Method of Color Measurement*, of SAE Standard J 578C, *Color Specification for Electric Signal Lighting Devices*.

Ap.A.2 *MOUNTING AND PHOTOMETRIC TESTING*

Ap.A.2.1 Adjustment - Test lamp position and test fixture may be adjusted within production tolerances.

Ap.A.2.1.1 The test fixture shall be oriented in accordance with the means of alignment required by ABYC A-16.8.3.

Ap.A.2.1.2 The vertical and horizontal test planes shall be referenced to the geometric center of the test lamp filament.

Ap.A.2.2 Test Lamp Selection - Test lamps used in testing for intensities, intensity distribution, and cut-off, unless otherwise specified, shall be representative of lamps in regular production, but shall be selected for accuracy of filament placement to design specifications.

Ap.A.2.3 Test Lamp Calibration - The test lamp shall be stabilized by proper seasoning, then calibrated to, and operated at, its design mean spherical candlepower, or a the design voltage as specified by the fixture manufacturer.

Ap.A.2.4 Test Lamp Seasoning - Proper seasoning of test lamps for photometric stability shall be carried out before calibration and use in accordance with that method specified by the lamp manufacturer; or, the test lamp may be seasoned for a minimum of 1 percent of average laboratory design life, or one hour, whichever is greater, but not to exceed 10 hours. Test lamps shall be seasoned at rated (design) voltage of the lamps.

Ap.A.2.5 Goniometry - Goniometry between photodetector and sample shall provide for horizontal measurement of 360^0, and a vertical measurement between 25^0 above and below the horizontal; both horizontal and vertical angles measurable within $\pm 0.2^0$ and accurate to $\pm 0.5^0$.

Ap.A.2.6 Photometer - A photometer suitable for measurement of directional light shall be capable of measurement of the luminous intensity distribution of the light emanating from the fixture to be tested. The photometer shall have an angle of view sufficient to subtend the entire lighted portion of the fixture. The photometer shall be photoptically corrected in accordance with *1931 CIE Standard Observer Photoptic Distribution (Y)*. This may be done using a suitable corrected photoptic filter in front of the detector or may be done digitally. Extraneous light must have no significant effect upon the detector. Means shall be provided to prevent same if necessary. The photometer shall be capable of measuring luminous intensity within an accuracy of 5 percent. The components of the optical system of the test fixture should be cleaned carefully, if necessary, before the test begins, but without injury or scratching the components, or adversely affecting any optics contained in the components.

Ap.A.2.7 Geometry - The distance between the source and the measuring apparatus should be great enough so that the source acts as a point source and the inverse square law applies. The distance shall be not less than 10 feet (3m).

Ap.A.2.8 Procedure - The photometer shall be calibrated prior to testing each model of navigation light. For combination sidelights, the photometer shall be calibrated prior to testing each color of each model navigation light. When testing combined lanterns only one color shall be tested at one time. The light of other colors shall not be allowed to influence the test results.

Ap.A.2.9 Measurement Points

Ap.A.2.9.1 Horizontal Angles

Ap.A.2.9.1.1 Sector Limits - At each end of the prescribed arc, measurements shall be made at 1^0 intervals, from 8^0 inside the lighted sector to the point at which the intensity is less than 10% of the required minimum intensity.

Ap.A.2.9.1.2 Interior of Lighted Sector - Measurements shall be made at intervals not to exceed 20^0 of arc.

Ap.A.2.9.2 Vertical Angles - Measurements shall be made in a vertical plane oriented 90^0 from either sector limit, except in the case of sidelights where the vertical plane shall be oriented 60^0 from the forward sector limit. Measurement shall be made on the intersection of this plane and the horizontal, 5^0 above and below the intersection, and either 7.5^0 or 25^0 above and below the intersection, depending on whether the light is intended for power boat or sailboat use respectively. Both of the latter shall be used for lights intended for either service.

Ap.A.2.10 Intensity/Nominal Voltage Test - The test fixture shall be tested for its ability to meet minimum required luminous intensity as specified in ABYC A-16, *Electric Navigation Lights*, Table II, when operated at its intended nominal system voltage. This shall be a single reading at a point selected by the fixture manufacturer. No other light or fixture characteristics other than minimum required luminous intensity are to be the subjects of this part of the testing.

A-16 APPENDIX B

Ap.B.1 The test for watertight lights shall be;

Ap.B.1.1 subject the light to a direct stream of water,

Ap.B.1.2 from a one inch nozzle,

Ap.B.1.3 at a pressure of 15 psi (100 kPa) at the nozzle,

Ap.B.1.4 with the nozzle 10 feet (3 meters) away,

Ap.B.1.5 with a water temperature approx. 50°F (10°C),

Ap.B.1.6 for a period of five minutes,

Ap.B.1.7 without leakage.

Ap.B.2 The test for weathertight lights shall be;

Ap.B.2.1 subject the light to a continuous water spray using as many nozzles as required against the entire top and all exposed sides of the structure,

Ap.B.2.1.1 for 15 minutes,

Ap.B.2.1.2 at a rate of at least two inches (50mm) per hour,

Ap.B.2.1.3 at an operating pressure of five psi (0.352 kilograms per square centimeter).

* * * * *

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